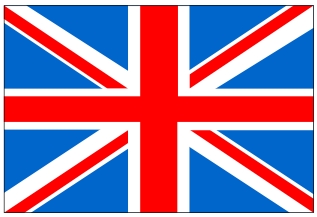
Operating Instructions for MAN Industrial Diesel Engines
Bedienungsanleitung für MAN-Industriedieselmotoren
Instrucciones de servicio para motores Diesel industriales MAN
Instruction de service pour moteurs Diesel industrieles MAN
Norme di servicio per motori Diesel industriali MAN

D 2876 LUH 01

Operating Instructions –
MAN Industrial Diesel Engines



Dear Customer,

these Operating Instructions are intended to familiarize you with your new MAN Diesel engine and how it operates.
The Publication “Fuels, Lubricants and Coolants for MAN Diesel Engines” supplements these Operating Instructions.

Note:
Both publications apply to the engine and must always be kept to hand in its vicinity in the engine room.

Please read this Manual and the “Instructions for the installation of MAN Diesel Engines” before you put the new engine into operation.

Comply in full with instructions relating to operation, prevention of accidents and environmental protection.

MAN Diesel engines are developed and manufactured in line with the latest state of the art. However, trouble-free operation and high performance can only be achieved if the specified maintenance intervals are observed and only approved fuels, lubricants and coolants are used.

It is imperative and in your own interest to entrust your MAN Local Service Centre with the removal of any disturbances and with the performance of checking, setting, and repair work.

Yours faithfully,
MAN Nutzfahrzeuge Aktiengesellschaft
Werk Nürnberg

Subject to change to keep abreast with technological progress.

MTDA Technical status: 06.2002 51.99493–8366

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Declaration

In accordance with Article 4, paragraph 2, in conjunction with Appendix II, section B, of Directive 89/392/EEC, version 93/44/EEC

MAN Nutzfahrzeuge Aktiengesellschaft,

hereby declares that the engine described below is destined for installation in a machine as defined in the EC directive on machines.

Engine model:

Design: *For data see original declaration*

Engine number: *If required this declaration is enclosed with the delivery note.*

Rating / speed:

Note:
The manufacturer of the complete ready-to-use machine in which this engine is to be installed must take the further action necessary in the context of indirect safety-related engineering and provision of instructions to ensure that the ready-to-use machine complies with the requirements of the EC directive on machines.

The engine must not be put into operation until the complete machine satisfies the conditions laid down in the EC directive on machines 89/392/EEC, most recently amended by 93/44/EEC, or the latest amendment of said directive.

MAN Nutzfahrzeuge Aktiengesellschaft

Vogelweiherstraße 33

D–90441 Nürnberg

In all your correspondence please always quote engine model, serial number and job number (Order number).

For this reason it is advisable to read off the data from the engine type plates before putting the engine into operation and to enter them in the appropriate spaces.

The engine type plates are on the crankcase.

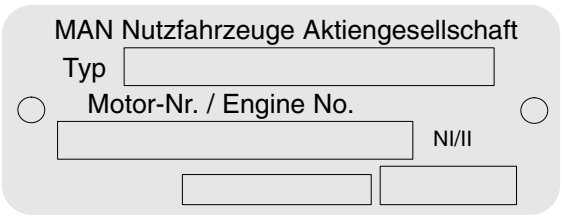
Model .....

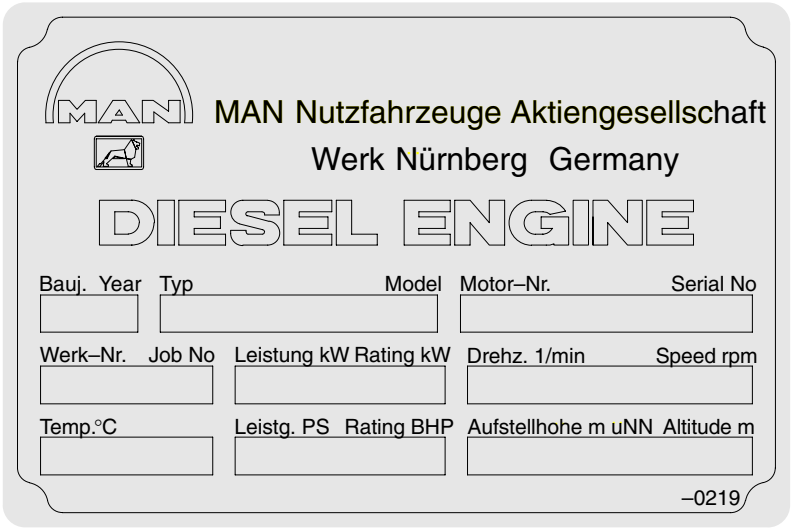
delivered on .....

installed on .....

Engine serial number .....

Order number .....





General notes

Day-to-day use of power engines and the service products (fuels, lubricants, coolants) necessary for running them presents no problems if the persons occupied with their operation, maintenance and care are given suitable training and think as they work.

This summary is a compilation of the most important regulations. These are broken down into main sections which contain the information necessary for preventing injury to persons, damage to property and pollution. In addition to these regulations those dictated by the type of engine and its site are to be observed also.

Important:
If, despite all precautions, an accident occurs, in particular through contact with caustic acids, fuel penetrating the skin, scalding from hot oil, anti-freeze being splashed in the eyes etc., ***consult a doctor immediately.***

1. Regulations designed to prevent accidents with injury to persons

During commissioning, starting and operation

- Before putting the engine into operation for the first time, read the operating instructions carefully and familiarize yourself with the “critical” points. If you are unsure, ask your MAN representative.

- For reasons of safety we recommend you attach a notice to the door of the engine room prohibiting the access of unauthorized persons and that you draw the attention of the operating personal to the fact that they are responsible for the safety of persons who enter the engine room.

- The engine must be started and operated only by authorized personnel. Ensure that the engine cannot be started by unauthorized persons.
- When the engine is running, do not get too close to the rotating parts. Wear close-fitting clothing.

- Do not touch the engine with bare hands when it is warm from operation – risk of burns.

- Exhaust gases are toxic. Comply with the instructions for the installation of MAN Diesel engines which are to be operated in enclosed spaces. Ensure that there is adequate ventilation and air extraction.

- Keep vicinity of engine, ladders and stairways free of oil and grease. Accidents caused by slipping can have serious consequences.

During maintenance and care

- Always carry out maintenance work when the engine is switched off. If the engine has to be maintained while it is running, e.g. changing the elements of change-over filters, remember that there is a risk of scalding. Do not get too close to rotating parts.

- Change the oil when the engines is warm from operation.
  Caution:
  There is a risk of burns and scalding. Do not touch oil drain plugs or oil filters with bare hands.

- Take into account the amount of oil in the sump. Use a vessel of sufficient size to ensure that the oil will not overflow.
- Open the coolant circuit only when the engine has cooled down. If opening while the engine is still warm is unavoidable, comply with the instructions in the chapter entitled “Maintenance and Care”.

- Neither tighten up nor open pipes and hoses (lube oil circuit, coolant circuit and any additional hydraulic oil circuit) during the operation. The fluids which flow out can cause injury.

- Fuel is inflammable. Do not smoke or use naked lights in its vicinity. The tank must be filled only when the engine is switched off.

- When using compressed air, e.g. for cleaning the radiator, wear goggles.

- Keep service products (anti-freeze) only in containers which can not be confused with drinks containers.

- Comply with the manufacturer’s instructions when handling batteries.
  Caution:
  Accumulator acid is toxic and caustic. Battery gases are explosive.

2. Regulations designed to prevent damage to engine and premature wear

Do not demand more from the engine than it is able to supply in its intended application. Detailed information on this can be found in the sales literature. The injection pump must not be adjusted without prior written permission of MAN Nürnberg.

If faults occur, find the cause immediately and have it eliminated in order to prevent more serious damage.

Use only genuine MAN spare parts. MAN will accept no responsibility for damage resulting from the installation of other parts which are supposedly “just as good”.

In addition to the above, note the following points:

- Never let the engine run when dry, i.e. without lube oil or coolant.
- When starting do not use any additional starting aids (e.g. injection with starting pilot).
- Use only MAN-approved service products (fuel, engine oil, anti-freeze and anti-corrosion agent). Pay attention to cleanliness. The Diesel fuel must be free of water. See “Maintenance and care”.
- Have the engine maintained at the specified intervals.
- Do not switch off the engine immediately when it is warm, but let it run without load for about 5 minutes so that temperature equalization can take place.
- Never put cold coolant into an overheated engine. See “Maintenance and care”.
- ***Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Do not exceed the maximum permissible tilt of the engine.***
  Serious damage to the engine may result if these instructions are not adhered to.
- Always ensure that the testing and monitoring equipment (for battery charge, oil pressure, coolant temperature) function satisfactorily.
- Comply with instructions for operation of the alternator. See “Maintenance and care”.

3. Regulations designed to prevent pollution

Engine oil and filter elements / cartridges, fuel / fuel filter

- Take old oil only to an old oil collection point.
- Take strict precautions to ensure that no oil or Diesel fuel gets into the drains or the ground.
  The drinking water supply could be contaminated.
- Filter elements are classed as dangerous waste and must be treated as such.

Coolant

- Treat undiluted anti-corrosion agent and / or anti-freeze as dangerous waste.
- When disposing of spent coolant comply with the regulations of the relevant local authorities.

4. Notes on safety in handling used engine oil *

Prolonged or repeated contact between the skin and any kind of engine oil decreases the skin. Drying, irritation or inflammation of the skin may therefore occur. Used engine oil also contains dangerous substances which have caused skin cancer in animal experiments. If the basic rules of hygiene and health and safety at work are observed, health risks are not to the expected as a result of handling used engine oil.

Health precautions:

- Avoid prolonged or repeated skin contact with used engine oil.
- Protect your skin by means of suitable agents (creams etc.) or wear protective gloves.
- Clean skin which has been in contact with engine oil.
  – Wash thoroughly with soap and water. A nailbrush is an effective aid.
  – Certain products make it easier to clean your hands.
  – Do not use petrol, Diesel fuel, gas oil, thinners or solvents as washing agents.
- After washing apply a fatty skin cream to the skin.
- Change oil-soaked clothing and shoes.
- Do not put oily rags into your pockets.

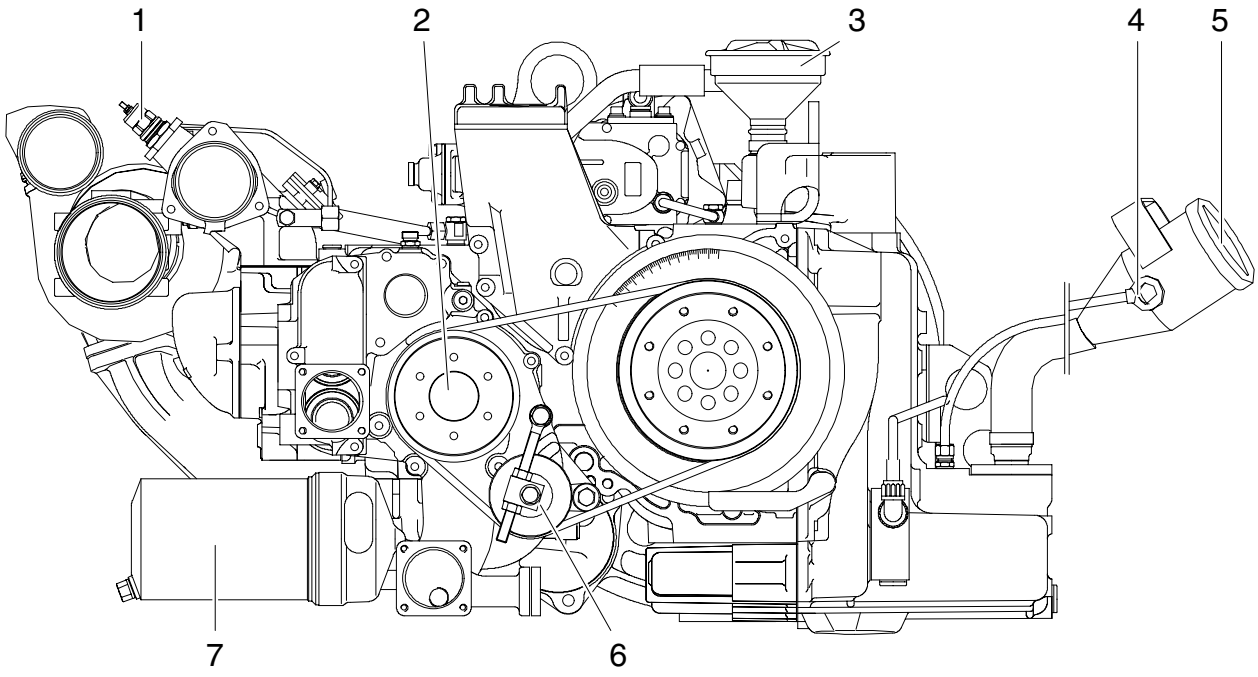
Ensure that used engine oil is disposed of properly
– Engine oil can endanger the water supply –

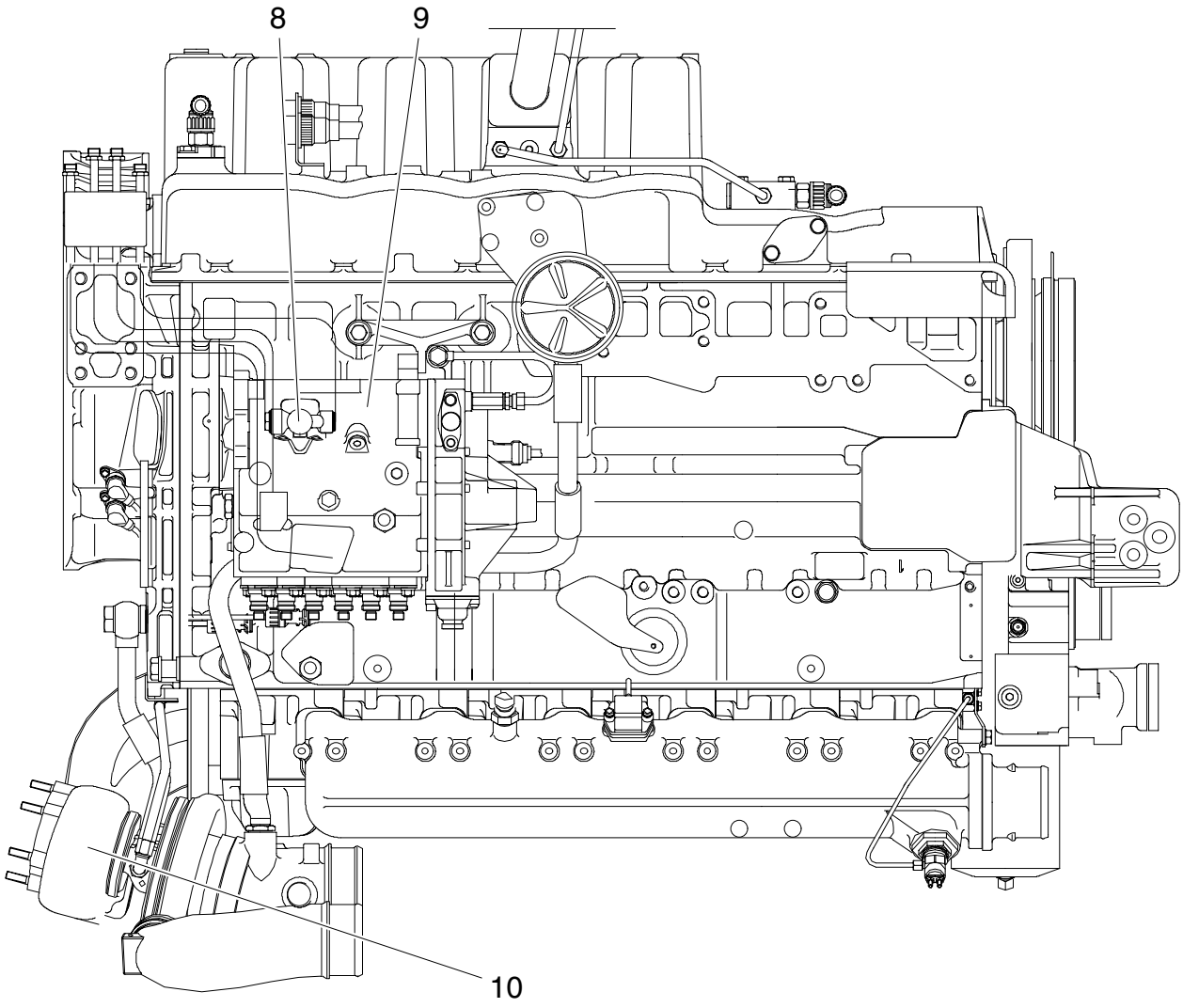
For this reason do not let engine oil get into the ground, waterways, the drains or the sewers. Violations are punishable.

Collect and dispose of used engine oil carefully. For information on collection points please contact the seller, the supplier or the local authorities.

* Adapted from “Notes on handling used engine oil”.

Engine views D 2876 LUH 01





1 Flame start glow plugs

2 Water pump

3 Crankcase breather

4 Oil dipstick

5 Oil filler neck

6 Tensioning pulley

7 Oil filter

8 Fuel lift pump

9 Injection pump

10 Turbocharger

First commissioning

At the time of initial commissioning of a new or overhauled engine make sure to have observed the “Technical Information for the installation of MAN Diesel engines”.
It is recommended that new or overhauled engines should not be operated at a load higher than about 75% maximum load during the first few hours of operation. Initial run-in should be at varying speeds. After this initial run-in, the engine should be brought up to full output gradually.

Note:
Use only approved fuels, lubricants etc. (see brochure “Fuels, lubricants etc.”).
Otherwise the manufacturer’s warranty will become null and void.

Filling with fuel

Caution:
Fill the tank only when the engine is switched off. Pay attention to cleanliness.
Do not spill fuel.
Use only approved fuels (see “Fuels, Lubricants etc.”)

Filling-in of coolant

Fill the cooling system of the engine with a mixture of drinkable tap water and anti-freeze agent on ethylene glycole basis or anti-corrosion agent.
See Publication “Fuels, Lubricants and Coolants for MAN Diesel Engines”.

- Comply with the vehicle manufacturer’s filling instructions
- Pour in coolant slowly (max. 10 ltr/min)

Filling with engine oil

Caution:
Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Overfilling will result in damage to the engine.

The engines are as a rule supplied without oil.
Pour oil into engine via filler neck, see page 21.
For the quantity required see “Technical Data”.

Note:
Before putting the hydraulic pump into operation for the first time fill it with oil.
Heed the manufacturer’s instructions!

Commissioning

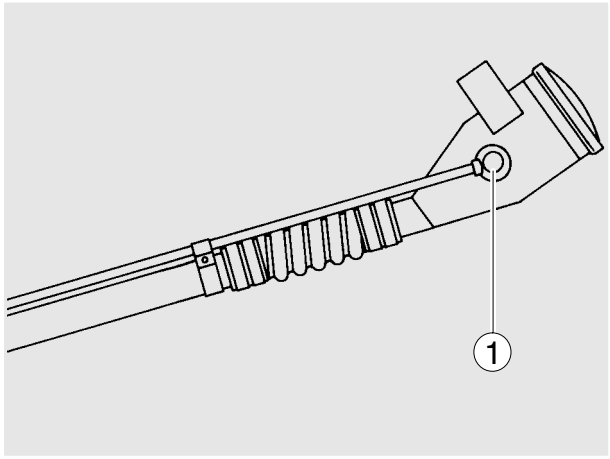
Before daily starting the engine, check fuel level, coolant level and engine oil level and replenish, if necessary.

Note:
Use only approved fuels, lubricants etc. (see brochure “Fuels, lubricants etc.”). Otherwise the manufacturer’s warranty will become null and void.

Checking oil level

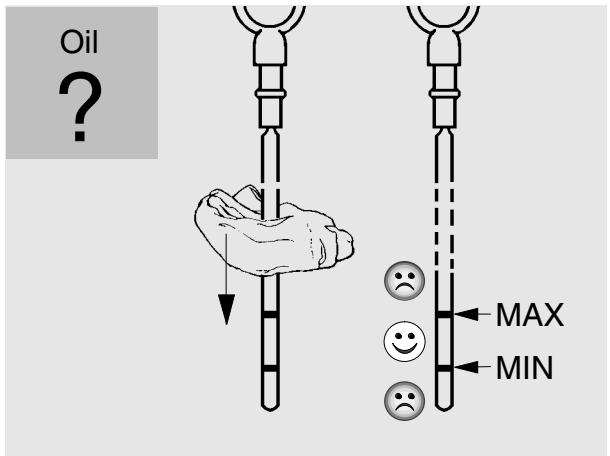
Check the oil level when the engine is horizontal, but only if at least 20 minutes have passed since the machine was switched off.

- Pull out dipstick ①
- wipe it with a clean, lintfree cloth
- and push it in again up to the stop
- Pull out dipstick again



The oil level should be between the two notches in the dipstick and must never fall below the lower notch. Top up oil as necessary.

Caution:
Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Overfilling will result in damage to the engine.



Ensure outmost cleanliness when handling fuels, lubricants and coolants.

Starting

Danger:
Before starting make sure that no-one is in the engine's danger area.

Caution:
When starting do not use any additional starting aids (e.g. injection with starting pilot).

In multi-engine systems the starting procedure is controlled by an automatic start-stop system.

This must fulfil the following functions:

- Switch on EDC
- Triggering of flame-start system
- The starting procedure is initiated at the end of the pre-glow period (starting aid) and interrupted when the engine starts at an engine speed of approx. 300–400 rpm.
- If the engine does not start – the starting time is limited to 10–15 seconds
- 3–4 further attempts to start with intervals of 15 to 20 seconds between them
- Fault message in event of unsuccessful attempt to start

Avoid running the cold engine for any length of time since in any internal combustion engine this is liable to cause increased wear due to corrosion. Prolonged idling is harmful to the environment.

Operation monitoring system

Caution:
Do not overload the engine. Do not exceed the maximum permissible engine tilt.
If faults occur, find their cause immediately and have them eliminated in order to prevent more serious damage!

During operation the oil pressure of the engine lubrication system and the coolant temperature must be monitored.
If the monitoring devices register a drop in the lube oil pressure, switch off the engine immediately.

Shutting down

Set engine to idle speed.

After engine has been operating at high loads let it idle for approx. 5 minutes.

Switch off engine via the EDC.

Danger:
Ensure that the engine can not be started by unauthorized persons.

Lubrication system

Ensure outmost cleanliness when handling fuels, lubricants and coolants.

Note:
Use only approved fuels, lubricants etc. (see brochure “Fuels, lubricants etc.”).
Otherwise the manufacturer’s warranty will become null and void.

Engine oil change

Danger:
The oil is hot- risk of scalding. Do not touch the oil drain plug with bare fingers. Oil is an environmental hazard. Handle it with care!

With the engine at operating temperature, remove the oil drain plugs on the oil sump and the oil filter bowl and allow the old oil to drain off completely.

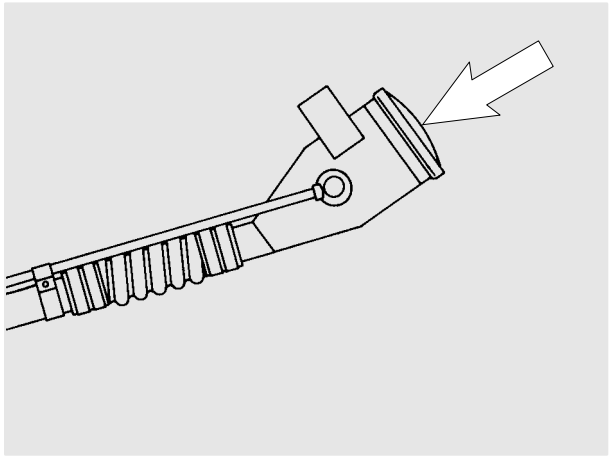
Use a vessel of sufficient size to ensure that the oil does not overflow.

Caution:
Used oil is dangerous waste.
Observe safety regulations to prevent damage to the environment.

Refit the oil drain plugs with new gaskets.

Refilling with oil

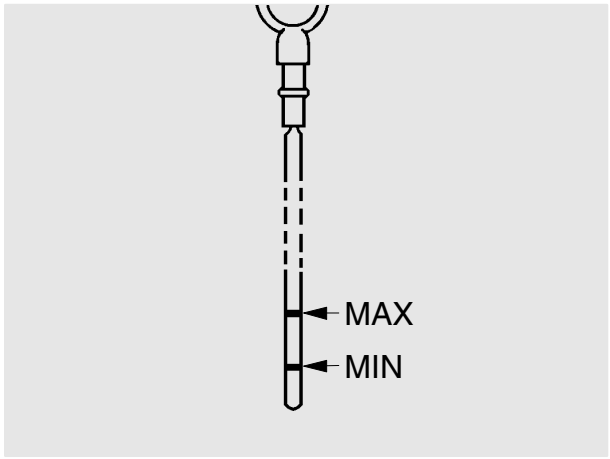
Caution:
Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Overfilling will result in damage to the engine.



Refill with fresh engine oil at the oil filler neck (arrow).

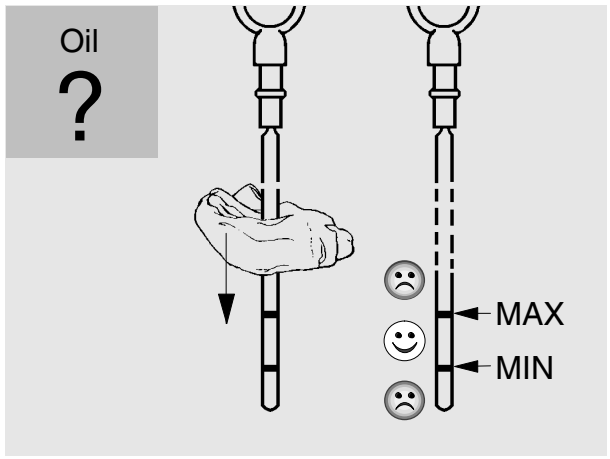
After filling start the engine and let it run for a few minutes at low speed.

Caution:
If no oil pressure builds up after approx. 10 seconds switch off the engine immediately.



Check oil pressure and check that there is no oil leakage.
Then shut down the engine. After about 20 minutes, check the oil level.

- Pull out dipstick
- wipe it with a clean, lintfree cloth
- and push it in again up to the stop
- Pull out dipstick again



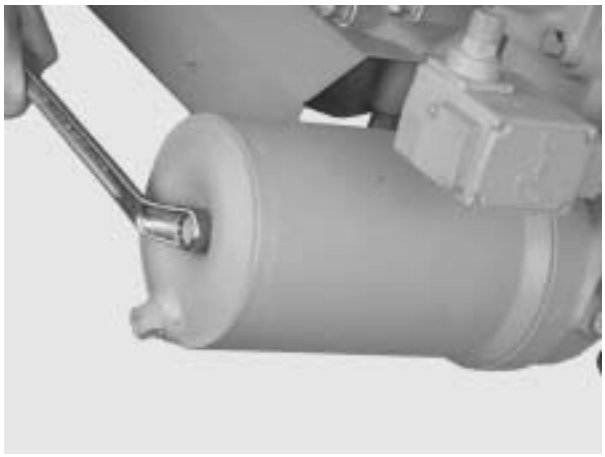
The oil level should be between the two notches in the dipstick and must never fall below the lower notch. Top up oil as necessary.

Changing oil filter

Caution:
Used oil and oil filters are classed as dangerous waste and must de disposed of accordingly. Note instructions for preventing environmental damage.

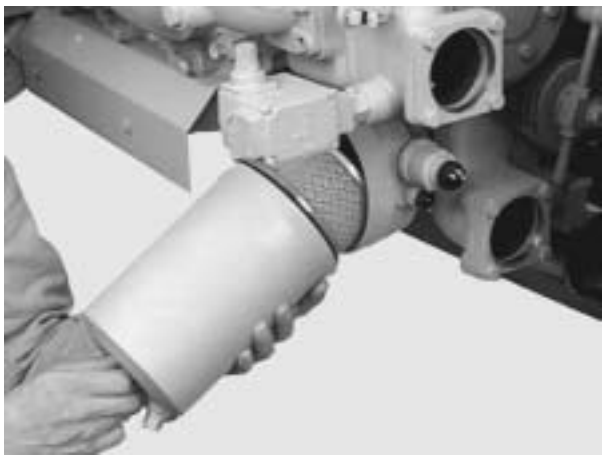
- Allow the filter content to run off along drain plug.
  Hold a suitable vessel under hole

Danger:
The oil is hot and under pressure when the drain plug is opened. Risk of burns and scalds.



- After releasing the clamping bolts remove filter bowl
- Refit oil drain plug with new seal
- Renew filter cartridge. Thoroughly clean all other parts in cleaning fluid
- Use new gasket for reassembly of filter bowls

Note:
To prevent the seal from twisting hold the filter bowl firmly when tightening the tensioning screw.



Caution:
Used oil filters are classed as dangerous waste and must be disposed of accordingly.

Fuel system

Fuel

If Diesel fuel which contains moisture is used the injection system and the cylinder liners / pistons will be damaged. This can be prevented to same extent by filling the tank as soon as the engine is switched off while the fuel tank is still warm (formation of condensation is prevented). Drain moisture from storage tanks regularly. Installation of a water trap upstream of the fuel filter is also advisable. Do not use any additives to improve flow properties in winter.

Injection pump

No alterations must be made to the injection pump. If the lead seal is damaged the warranty on the engine will become null and avoid.

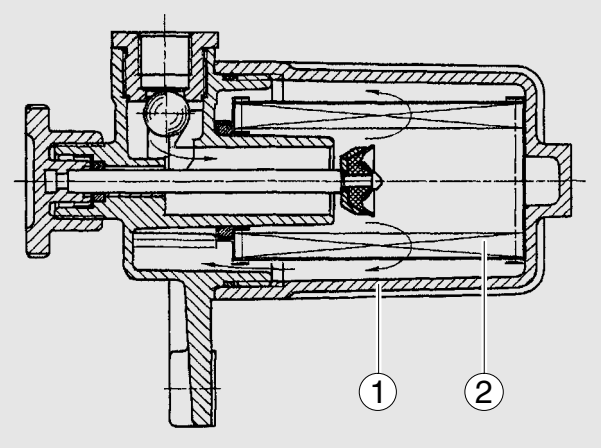
Faults

We urgently recommend that you have faults in the injection pump rectified only in an authorised specialist workshop.

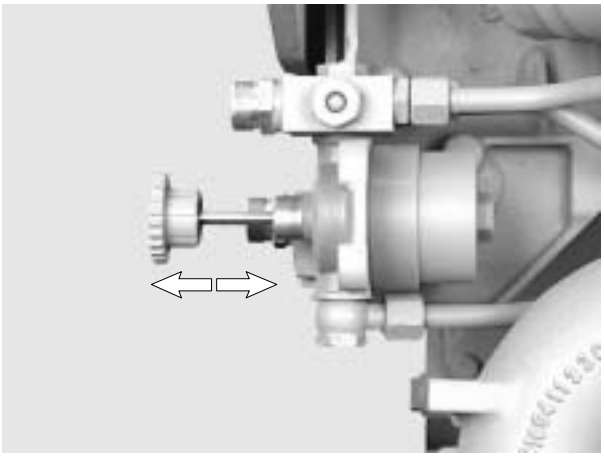
Cleaning fuel pre-cleaner

Strip the fuel pre-cleaner:

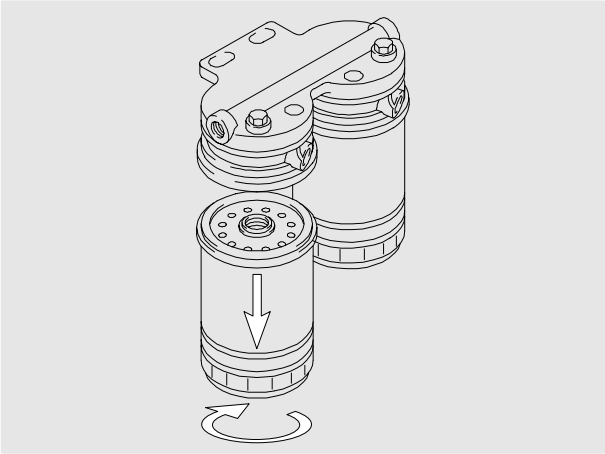
- Remove filter housing ①
- Wash out filter housing ① and gauze filter ② in clean Diesel fuel and blow them out with compressed air
- Reassemble using new seal
- Screw on filter housing and tighten it to 10–12 Nm



- Actuate plunger of hand priming pump until the overflow valve of the injection pump opens audibly
- Screw in the tappet of the hand pump again and tighten it
- Start engine
- Check fuel pre-cleaner for leaks



Fuel filter



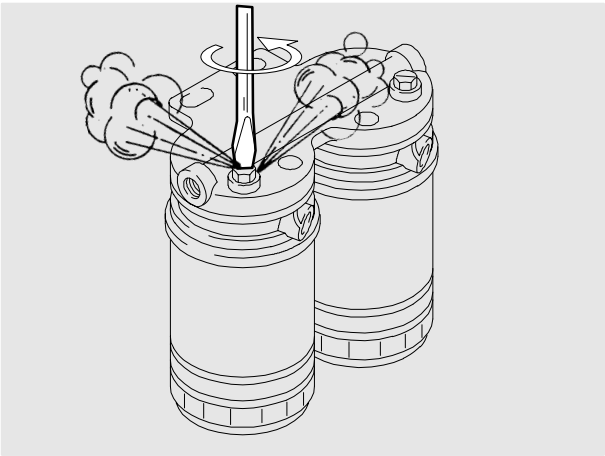
Changing fuel filter

Only when engine is switched off

- Loosen filter cartridge by means of tape wrench, unscrew it by hand and take it off
- Moisten the seals on the new filter cartridge with fuel
- Screw on the filter cartridges and tighten them vigorously by hand
- Bleed fuel system
- Check filter for leaks

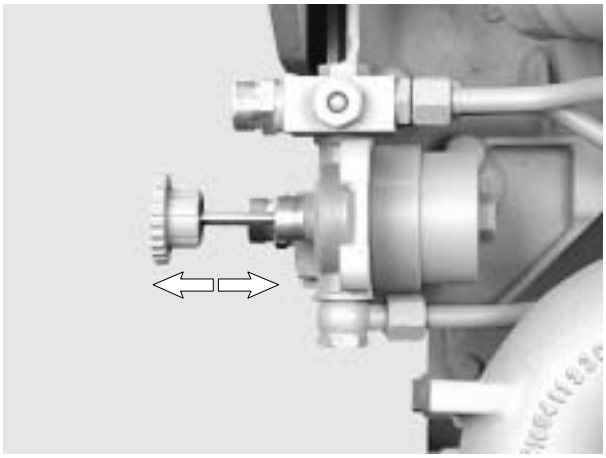
Caution:
Used fuel filters are classed as dangerous waste and must be disposed of accordingly.

Bleeding the fuel system



An arrow on the filter head indicates the direction of fuel flow.

- Unscrew bleed screw of first filter in direction of flow by one or two turns
- Actuate tappet of hand primer until fuel emerges without bubbles
- Screw in the tappet of the hand pump again and tighten it
- Close bleed screw again
- Repeat this procedure at the second bleed screw
- Check fuel system for leaks



Cooling system

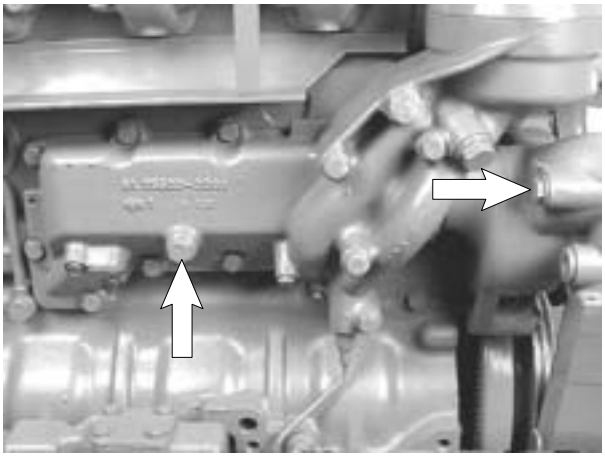
Danger:
Draining hot coolant involves a risk of scalding.

Draining the cooling system

Drain coolant as follows when cooling system has cooled down:

Caution:
Drain coolant into a suitable container and dispose of it in accordance with regulations.

- Open overflow pipe of expansion tank to equalise the pressure
- Remove drain plugs (arrows) and then take off the cap
- Drain coolant into a container of adequate size
- Refit screw plugs
- Fill / bleed the cooling system



Fill / bleed the cooling system (only when engine has cooled down)

Fill the cooling system of the engine with a mixture of drinkable tap water and anti-freeze agent on ethylene glycole basis or anti-corrosion agent.
See Publication “Fuels, Lubricants and Coolants for MAN Diesel Engines”.

The coolant must be poured in in accordance with the instructions of the vehicle manufacturer.
Do not put cold coolant into an engine which is warm from operation.

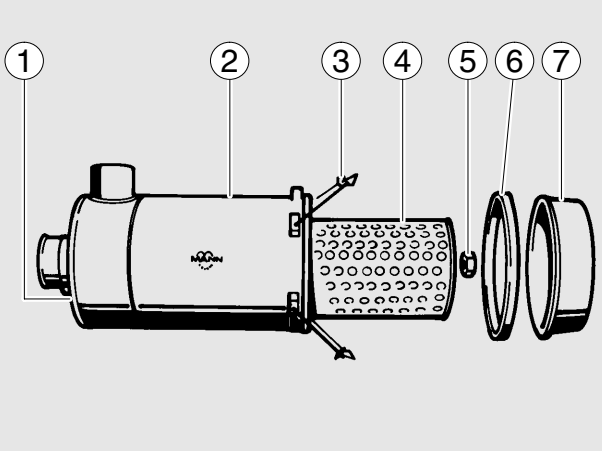
Ensure that the ratio of water to anti-freeze is correct.

- Pour in coolant slowly (max. 10 ltr/min)
- Run the engine briefly and then check coolant level once more

Danger:
If, in an **exceptional** case, the coolant level has to be checked in an engine that has reached operating temperature, first carefully turn the cap with safety valve to the first stop, let off pressure, then open carefully.

Air filter

Dry air filter



1 Connection for contamination gauge
2 Filter housing
3 Retainer
4 Filter cartridge
5 Hex nut
6 Lid
7 Dust collector

Service only when engine is switched off.

Dust collector

The dust collector must be emptied at regular intervals. The collector should never be more than half full of dust.

When the two retainers have been folded up the dust collector can be taken off. Remove the lid of the dust collector and empty the collector.

Ensure that the lid and the collector are reassembled correctly. A lug on the collector fits into a recess in the edge of the lid. If the filter is installed horizontally note the “oben” (top) marking on the filter bowl.

Contamination gauge

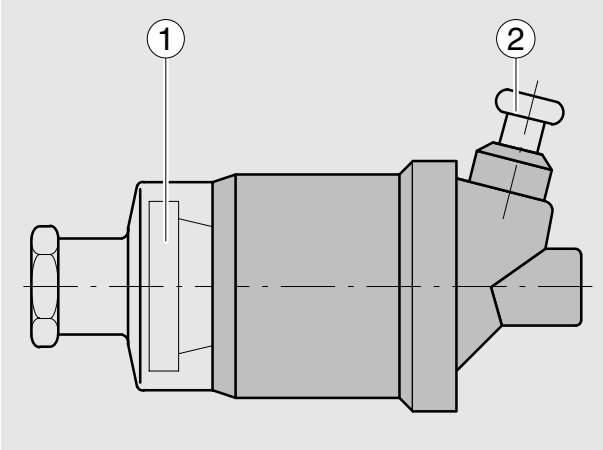
Mechanical

1 Red display cylinder
2 Return knob

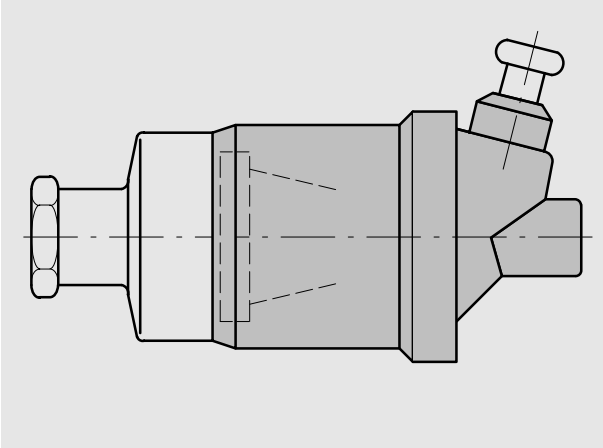
In the window a red field appears which grows in size as the contamination increases.

If the red field is fully visible in the window, the air filter is contaminated and must be cleaned or changed.

When the filter has been changed pull the return knob. The red field then disappears.



Display: filter service is due



Display: filter is ready for operation

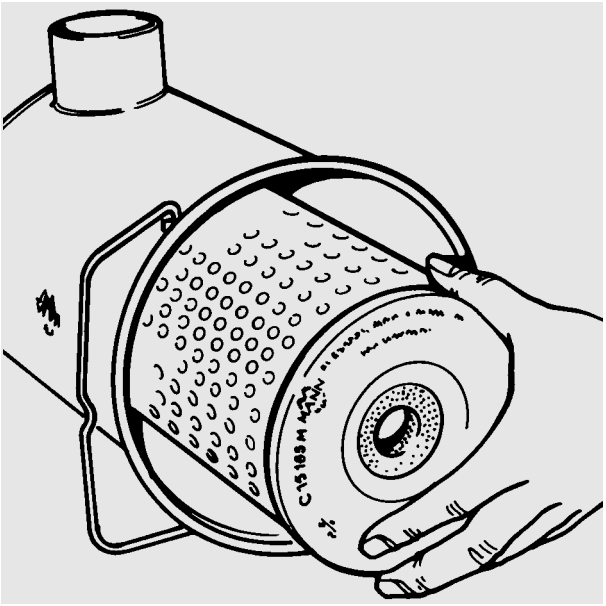
Changing the filter cartridge

Caution:
No dust must get to the clear air end.

Remove the hex hut, take out the contaminated cartridge and fit a new one.

Clean the filter housing with a damp cloth, especially at the sealing face for the cartridge.

Caution:
The engine must not be run without a main cartridge.



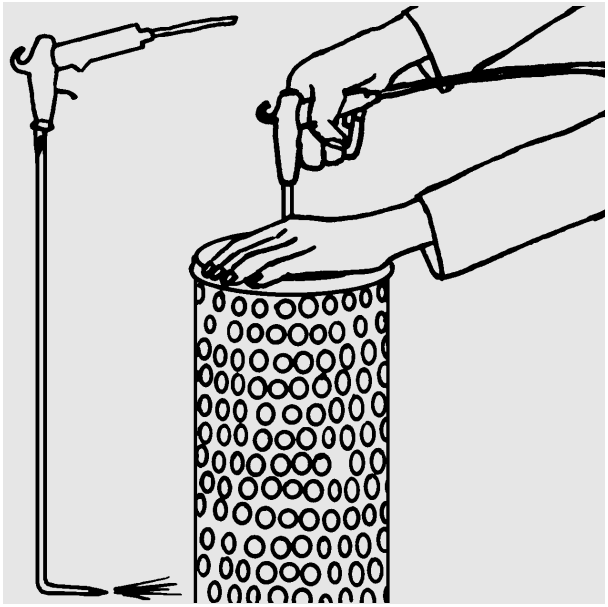
Cleaning the cartridge

Caution:
The filter cartridge should normally be changed. Clean it only in emergencies (e.g. when no replacement is available).

Blowing out *(wear goggles)*

To do this fit a pipe to the compressed air gun. The end of the pipe should be bent by approx. 90°. The pipe must be long enough to reach the bottom of the cartridge.

Blow the cartridge out from the inside with dry compressed air (max. 5 bar) by moving the pipe up and down inside the cartridge until no more dust is released.

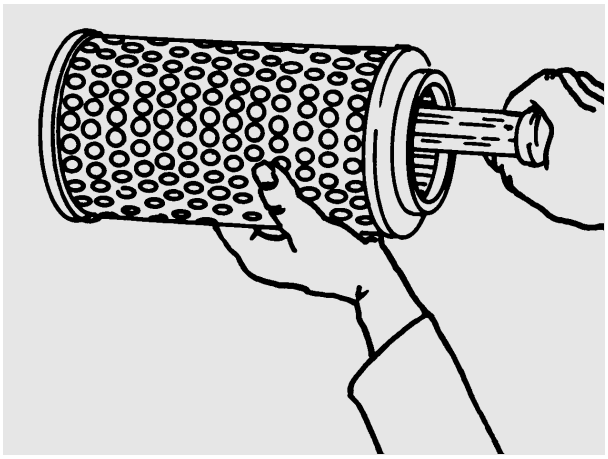


Checking the cartridge

When a cartridge has been cleaned it must be examined for damage before it is refitted, e.g. damage to the paper bag and rubber seals. Check also for compression of or dents in the metal jacket.

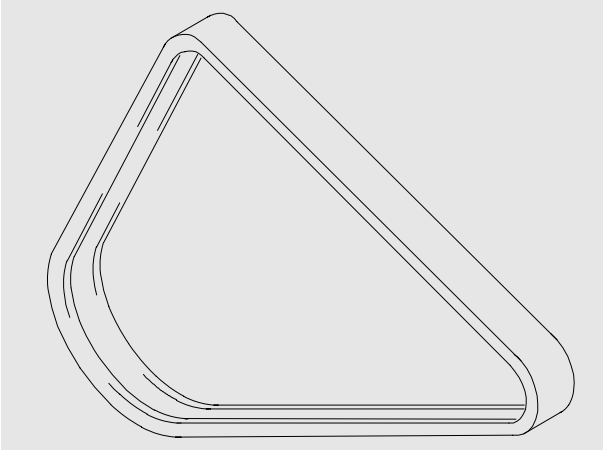
Tears and holes in the paper bag can be found by shining a torch into the bag.

On no account re-use damaged cartridges. If in doubt fit a new cartridge.



Checking V-belts

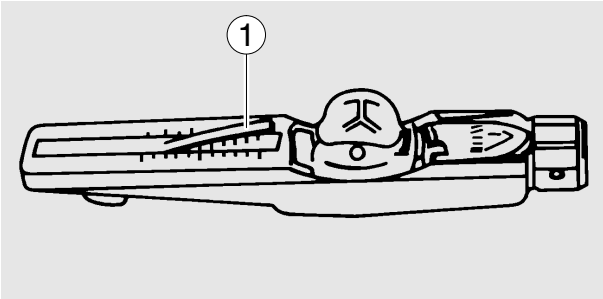
Checking condition



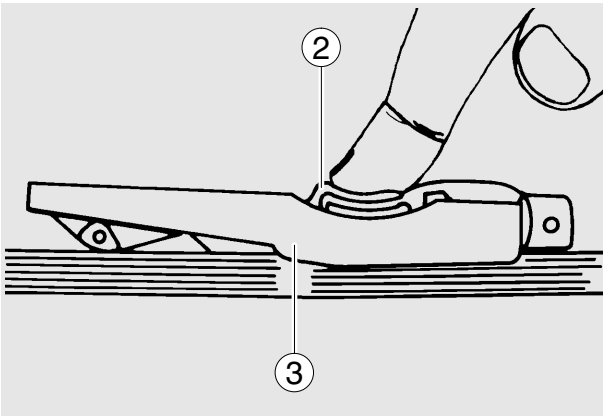
- Check V-belts for cracks, oil, overheating and wear
- Change demaged V-belts

Checking tension

Use V-belt tension tester to check V-belt tension.



- Lower indicator arm ① into the scale
- Apply tester to belt at a point midway between two pulleys so that edge of contact surface ② is flush with the V-belt
- Slowly depress pad ③ until the spring can be heard to disengage. This will cause the indicator to move upwards



If pressure is maintained after the spring has disengaged a false reading will be obtained!

Reading of tension

- Read of the tensioning force of the belt at the point where the top surface of the indicator arm ① intersects with the scale
- Before taking readings make ensure that the indicator arm remains in its position

If the value measured deviates from the setting value specified, the V-belt tension must be corrected.

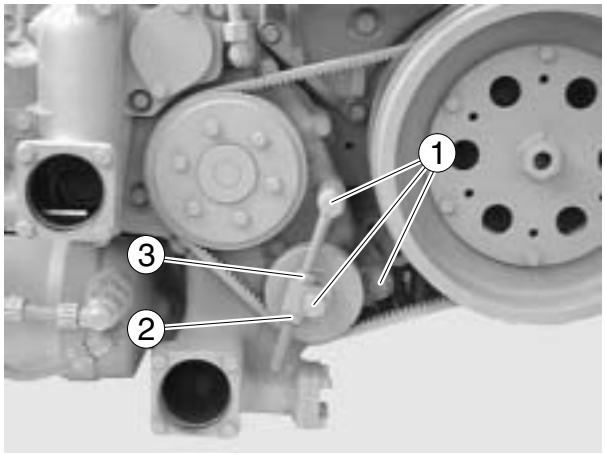
Drive belt width	Tensioning forces according to the kg graduation on the tester		
	New installation		When servicing after long running time
	Installation	After 10 min. running time	
2/3VX	90–100	70–80	60

Tensioning and changing V-belt

Crankshaft – water pump – tension pulley

- Remove fixing bolts ①
- Remove lock-nut ②
- Adjust nut ③ until V-belts have correct tensions
- Retighten lock-nut and fixing bolts

To replace the V-belts loosen lock-nut and swing tension pulley inwards.



Turbocharger

At every engine oil change check the oil pipes for leaks and constrictions.

Furthermore, a regular check should be kept on charge air and exhaust gas pipes. Any leakages should be attended to at once because they are liable to cause overheating of the engine.

Intercooler

If the coolant output is to be retained as far as possible, the intercooler must be cleaned at certain intervals.

Starter motor

Check that the electric cables are properly fastened and that contacts and plug connections are secure.

In engines fitted with electronic speed pickups at the gear ring (e.g. electronic speed governor and EDC), the speed pickup are to be cleaned too and metal chips that may adhere are to be removed.

Caution:
Always disconnect the battery earth cable before starting work on the electrical system. Connect up the earth cable last, as there is otherwise a risk of short-circuits.

Temporary decommissioning of engines

Temporary anti-corrosion protection according to MAN works norm M 3069 is required for engines which are to be put out of service for fairly long periods.

The works standard can be obtained from our After-Sales Service department in Nuremberg.

Model	**D 2876 LUH 01**
Design	In-line, underfloor design
Cycle	4-stroke Diesel with turbocharger and intercooler
Combustion system	Direct injection
Turbocharging	Turbocharger with intercooling
Number of cylinders	6
Bore	128 mm
Stroke	166 mm
Swept volume	12 816 cm^3
Compression ratio	17 : 1
Rating	294 kW / 400 hp at 2000 rpm
Firing order	1–5–3–6–2–4
Valve clearance (cold engine)	
Intake	0.50 mm
Exhaust	0.50 mm
Valve timing	
Intake opens	23° before TDC
Intake closes	12° after BDC
Exhaust opens	60° before BDC
Exhaust closes	30° after TDC
Fuel system	
Injection	In-line injection pump with automatic adjustment of start of injection
Governor	Electronically controlled diesel injection (EDC) – model MS 5.3
Start of delivery	4–1° before TDC
Injectors	7-orifice nozzles
Opening pressure of injector	
New nozzle holder:	320+8 bar
Used nozzle holder:	300+8 bar

Engine lubrication	Force feed	
Oil capacity in oil sump (litres)	min.	max.
	24 l	30 l
Oil change quantity (with filter)	33 l	
Oil pressure during operation (depending on oil temperature, oil viscosity class and engine rpm)	must by monitored by oil pressure monitors / gauges	
Oil filter	Full flow filter with paper cartridges	
Engine cooling system	Liquid cooling	
Operating temperature	80–90°C, temporarily 95°C allowed	
Electrical equipment		
Starter	24 V; 5.4 kW	

ALWAYS COMPLY WITH SAFETY REGULATIONS !									
Maintenance cycles in hours of operation	**Maintenance jobs**								
Daily	K								
20	A		C				I	J	
400	A		C	D	E		I	J	
800	A		C		E		I	J	
1200	A1		C				I	J	
1600	A		C		E		I	J	
2000	A		C				I	J	
2400	A1		C		E		I1	J	
2800	A		C				I	J	
3200	A	B	C		E		I	J	
3600	A1		C				I	J	
4000	A		C		E		I	J	
4400	A		C				I	J	
4800	A1		C		E		I1	J	
5200	A		C				I	J	
5600	A		C		E		i	J	
6000	A1		C				I	J	
6400	A	B	C		E	F	I	J	
6800	A		C				I	J	
7200	A1		C		E		I1	J	
7600	A		C				I	J	
8000	A		C		E		I	J	
8400	A1		C				I	J	
8800	A		C		E		I	J	
9200	A		C				I	J	
9600	A1	B	C		E		I1	J1	
10000	A		C				I	J	
10400	A		C		E		I	J	
10800	A1		C				I	J	
11200	A		C		E		I	J	
11600	A		C				I	J	
12000	A1		C		E		I1	J	
12400	A		C				I	J	
12800	A	B	C		E	F	I	J	
13200	A1		C				I	J	
13600	A		C		E		I	J	
14000	A		C				I	J	
14400	A1		C		E		I1	J	
14800	A		C				I	J	
15200	A		C		E		I	J	
15600	A1		C				I	J	
16000	A	B	C		E		I	J	

A	Clean water separator / pre-filter
A1	Change fuel filter, clean water separator, clean pre-filter
B	Check injection nozzles, compression pressure, renewing if required
C	• Change oil and oil filter, check that components are tight • Check V-belts for damage, tighten up or change
D	Tighten cylinder head bolts
E	• Check valve clearance and adjust if necessary • Check connection elements (bolts, clamps etc.) and tighten if necessary
F	Renew axial face seal and bearing on water pump
I	Clean air filter and change filter cartridge, set back display
I1	Change air filter / filter cartridge
J	Check concentration of coolant, correcting if necessary
J1	Renew coolant
K	• Check oil level • Check coolant level • Check maintenance display on air filter • Check water separator (if there is one) • Check regarding pending EDC errors • Visual check for exterior damage, stone impact, leakages

The prescribed maintenance intervals presuppose the use of engine oil as per MAN works norms M3275 or M3277!

Note:
Since the engines will display long day running time with high idling proportion, we believe it urgently necessary to carry out maintenance after a time limit.
At an estimated daily engine running time of 14 hours, the 400 hour cycle would roughly corresponds to one monthly maintenance service per month.
Since the actual wear and tear on the components is essentially dependent on these special conditions of use and lubricants, the wear and tear limit of the individual assemblies cannot be clearly forecast.
Preventive maintenance includes the precautionary exchange of wear and tear parts and components before they reach the end of their service life. This minimises the risk of unforeseeable repair measures between intervals.

1. EDC self-diagnosis or flash code output	2. Starter turns over engine only slowly or not at all	3. Starter turns, engine does not start, engine does not start / difficult to start when cold	4. Engine stalls (dies) during operation, no longer starts (starter turns), engine does not start / starts with difficulty when hot	5. Sudden, temporary engine shutdown, engine does not reach full revs	6. Engine only runs at idle speed, no throttle response	7. Engine only runs at increased idle speed, no throttle response	8. Rated engine speed distinctly reduced (even under no load)	9. Reduced output in all ranges	10. Irregular engine operation, traction loss	11. Unstable idle speed, engine hunting, misfiring, knocking in engine	12. Engine judder	13. Unusual combustion noise	14. Excessive smoke emission: White smoke / blue smoke	15. Excessive smoke emission: Black smoke	16. Engine temperature too high (coolant loss)	17. Intermediate engine speed control cannot be activated / does not switch off, engine revs too high	18. Fuel consumption too high	19. Lubricating oil pressure too low	20. Lubricating oil pressure too high	21. Lubricating oil consumption too high	22. Engine too “loud” / mechanical noise	**Possible causes**
x	x																					Batteries discharged, battery lead connections loose or corroded, break in power circuit
x																						Crank gear blocked
x	x																					Starter solenoid switch sticks (clicks) / defective, cable connection loose or damaged
x	x																					Starter / starter interlock relay defective (carbon brushes worked loose / worn, winding defective, short to ground)
x																	x	x	x			Engine oil viscosity unsuitable, not suitable for ambient temperature, lubricating oil quality does not correspond to specifications
	x					x													x			Oil level in sump too high
	x																x					Oil level in sump too low, oil in sump too thin (mixed with condensate or fuel)
																	x					Engine temperature too high
																	x					Oil filter clogged
																	x	x				Oil pressure gauge defective
																	x					Safety valve in oil circuit defective (does not close, spring fatigued or broken)
																	x				x	Bearing wear
																	x					Oil pump gears worn
																					x	Crankshaft timing gears worn, tooth flank backlash too great
								x		x								x				Engine cold
										x												Lubricating oil entering combustion chamber (piston rings worn, piston rings broken) – valve stem guide worn – overpressure in crankcase (crankcase vent clogged)
																		x				Relief valve in oil circuit defective (does not open), oil lines / oil galleries clogged
																			x			Leaks in lubricating oil circuit, particularly at turbocharger and oil cooler
								x		o									x			Piston rings heavily worn, broken
								x													x	Piston pin or crankshaft bearing loose
										o									x			Valve stems worn, bent
	x							x													x	Valve clearance not correct
	x							x														Valves jam
	x	x				x		x														Compression deficient, or more than 3–4 bar pressure difference between individual cylinders
	x							x				x										Valve seats leaking
o			x									x										Increased power intake due to defective secondary consumers such as hydraulic pumps, fan etc., power take-off engaged
			x			x				x		x									x	Air cleaner soiled or clogged, turbo air system leaking, air inlet / exhaust line clogged / leaking
	x	x	x	x		x	x		x		x		x									Fuel low pressure system: Fuel tank, prefilter, water trap faulty / clogged / mould / fungal attack, fuel unsuitable / contaminated (paraffin added)

x = Possible
o = Probable

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	x	x	x			x	x	x			x				x							Fuel low pressure system: Fuel lines leaking, broken, clogged
	x	x	x			x	x		x		x											Fuel low pressure system: Air in system (turn on ignition when bleeding system)
	x	x	x			x	x	x	x		x				x							Fuel low pressure system: Fuel pump, overflow valve, main filter
	x					x		x	x	x	o	x			x							Fuel high pressure system: Jets defective / clogged / leaking / coked
						x		x	x	x					o							Fuel high pressure system: Pressure lines – constriction, cavitation, leaking
		x				x		o	x	x	x	x			o							Fuel high pressure system: Injection pump worn / set incorrectly
						o			x	o					o							Fuel high pressure system: Injection pump constant-pressure control valve / return flow restrictor defective
	x	x	x			o	x															Safety relay defective drive faulty
	o	o				o		x		o	x	x			x							Injection pump-engine allocation: Start of delivery incorrect (basic installation), start of delivery set incorrectly
x	x	x	x			o		x	o													Injection pump – controller: Stiff movement – fuel delivery controller (control deviation)
x	x	x	x				o															Control rod position transducer in controller: Connection lines, break, short-circuit
	o					o						o										Control rod position transducer in controller: Set incorrectly
x	x		o																			Control rod position transducer in controller: Capacitance reserve of wiring harness too low (e.g. water penetrated wiring harness)
						x		o	x	o		o										Injection pump: Delivery set incorrectly / uniform delivery, lower idle speed set too low
x	o	x	x										x									Delivery actuating solenoid in controller: Connection lines, break, short-circuit
x				x		o	o	o														CAN control system has failed / is defective: Connection lines, short-circuit, break
x																						EDC rpm sensor defective, implausible with auxiliary rpm sensor, line defective
								x	o													EDC rpm sensor, polarity reversed
x																						EDC auxiliary rpm sensor defective, implausible with rpm sensor, line defective
x	x	x	x	o			o	o					o									EDC detects incorrect engine speed (interference signal on rpm sensor line)
x	x	x	x						o													Both rpm sensors defective, line defective
x						x						x										EDC turbo pressure sensor: Defective, incorrect, implausible with atmospheric pressure sensor, line defective
						x		x		o	x											Exhaust turbocharger leaking or defective
																					x	Turbine and compressor rotor in turbocharger dirty (out-of-balance, irregular running)
						x						x										Intercooler leaking, defective
	x									x												Flame starting system defective
x	o					x	o					x										EDC coolant temperature sensor: Defective, line defective
x						x	o															EDC turbo air temperature sensor: Defective, line defective
o						x						x										Radiator dirty or failure of cooling system (temperatures too high)
		x										x										Coolant level too low, air in coolant circuit

x = Possible
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1. EDC self-diagnosis or flash code output																						
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																			20. Lubricating oil pressure too high		
																				21. Lubricating oil consumption too high	
																					22. Engine too “loud” / mechanical noise
																						Possible causes
														x								V-belt for water pump drive not tensioned correctly
														x							x	Incorrect V-belt tension
														x								Water pump leaking, defective / thermostat defective, does not open
														x								Coolant lines leaking, clogged or twisted
												x										Coolant entering combustion chamber (cylinder head / gasket leaking)
								x						o								Resistor bank EDC control unit pin 51
x		x	x	o				o														Power supply to EDC control unit interrupted or battery voltage too low
		x	x	o				o														Line terminal 15 to EDC control unit (pin 47) interrupted / loose contact
															x							Line defective: Pin 23 or 41
x		o	o	o																		EDC control unit defective (internal fault)
		x			o	x	x		o	o		o	x									Incorrect EDC control unit (check MAN part number)
					x	x									o							Incorrect intermediate speed switched on
		x																				EOL programming terminated / voltage interrupt
x																						Afterrunning not completed (e.g. shutdown via EMERGENCY STOP)
															x							EOL programming: Configuration incorrect
									x													Engine bearings worn

x = Possible
o = Probable

MAN Nutzfahrzeuge Aktiengesellschaft
Vogelweiherstraße 33
D-90441 Nürnberg

Printed in Germany 51.99493-8366